

REMARKS

In response to the Office Action mailed February 26, 2004, Applicants respectfully request reconsideration. Claims 1-15 are currently pending in this application.

The Office Action rejected claims 1-5 and 8-9 under 35 U.S.C. §103(a) as purportedly being obvious over Song (5,546,599) in view of Grochowski (6,353,883) and claims 10 and 13 under 35 U.S.C. §103(a) as purportedly being obvious over the combination of Song and Grochowski further in view of Hennessy (Hennessy and Patterson, Computer Architecture – A Quantitative Approach, 2nd Edition, 1996). The Office Action further rejected claims 6, 7, 11, 12, 14, and 15 under 35 U.S.C. §103(a) as purportedly obvious over the combination of Song and Grochowski further in view of various other references. For the reasons discussed below, each of these rejections is respectfully traversed and the application as presented is believed to be in condition for allowance.

In paragraphs 3 and 4, the Office Action notes that in an IDS filed by Applicants on December 22, 2000 and in a subsequent IDS filed by Applicants on April 14, 2003, Applicants cited a reference (McFarland) a copy of which was not provided along with the IDS and also provided copies of several references (Pardo, Karp, and Nemirovsky) that were not cited in either IDS. Applicants intend to file an additional IDS to properly cite McFarland, Pardo, Karp, and Nemirovsky.

In paragraph 5, the Office Action objected to various informalities in the specification. Applicant has amended the specification to correct each of these informalities. Accordingly, it is respectfully requested that the objection to the specification be withdrawn.

In paragraph 6, the Office Action objected to page 17 of the specification because reference number 104 and 230 are mentioned but are not found in the drawings. Applicant has amended the specification to change these reference numbers to 38 and 130 respectively. Accordingly, it is respectfully requested that the objection be withdrawn.

In paragraph 7, the Office Action objected to Figure 2, asserting that reference numbers 46 and 47 are not found in the description. The Office Action further objected to Figure 7, asserting that the field to the right of the 'sgls' field has not been mentioned within the description and objected to Figure 10, asserting that reference number 130 is not found in the description. With respect to the objections of Figure 2, Applicants note that reference numbers

46 and 47 are mentioned in the description. The Examiner's attention is drawn to the third paragraph on page 12 which discusses divert signal 46 and to page 11, line 32 of the specification which discusses program status register 47. With respect to the objection to Figure 7, Applicants have corrected Figure 7 to remove the name of the field to the right of the 'sgls' field. With respect to Figure 10, as discussed above, page 17 of the specification has been amended to correct reference number '230 to read '130'. Accordingly, withdrawal of these rejections is respectfully requested.

In paragraph 8, the Office Action objected to Figure 2, asserting that both reference numbers 4 and 18 refer to the processor core. As is clear from Applicant's specification, reference number 4 refers to the processor, whereas reference number 18 refers to the processor core. This is clear from Applicants' specification on page 6, second paragraph, which states that the processor 4 comprises a processor core 18. Applicants have further corrected an error in the second paragraph on page 6, which inadvertently referred to "processor 4" as "core 4." Accordingly withdrawal of this objection is respectfully requested.

The Office Action, in paragraph 8, also asserts that reference numbers 6 and 32 in Figure 2 "have both been used to designate the OCE PC Watch component." Applicants respectfully disagree. As stated on page 9, second paragraph of Applicants' specification, "OCE block 6 comprises a PC watch block 32." Thus, the PC watch block 32 is a component of OCE block 6. To further clarify this, Applicants submit a corrected Figure 2, indicating more clearly that PC watch block 32 is a component of OCE block 6. Accordingly, withdrawal of this objection is respectfully requested.

In paragraph 9, the Office Action objected to Figure 2, asserting that "divert" is misspelled as "divet." Applicants submit herewith a corrected Figure 2 to correct this misspelling. Accordingly, withdrawal of this rejection is respectfully requested.

In paragraph 10, the Office Action objected to claim 1, asserting that "supplied and from" should read "supplied from." Claim 1 has been amended corrected accordingly. Thus, it is respectfully requested that the objection to claim 1 be withdrawn.

The Office Action rejected independent claim 1 under 35 U.S.C. §103(a) as purportedly being obvious over Song and Grochowski and independent claim 10 under 35 U.S.C. §103(a) as purportedly being obvious over Song and Grochowski, further in view of Hennessy.

Specifically, with regard to claim 10, the Office Action asserts that Song “has not explicitly taught that according to a precise watch mode, the instruction is not decoded. However, Hennessy has taught that exceptions (breakpoints) may occur when an instruction is fetched.”

Applicants believe that the limitation of claim 1 that, prior to the present amendment recited, “wherein according to a precise watch, the instruction causing the breakpoint is held at the decode unit,” means that the instruction is not decoded. However, because the Office Action concedes that Song does not disclose not decoding the instruction in a precise watch mode and because the Office Action does not employ Hennessy in the rejection of claim 1, Applicants understand the Office Action to interpret the above-quoted limitation of claim 1 as not requiring not decoding the instruction. Thus, Applicants have amended claim 1 to clarify that, according to a precise watch, the instruction is not decoded. In view of this amendment, Applicants treat the rejection of claim 1 as a rejection under Song, Grochowski, and Hennessy, as applied to claim 10.

Nevertheless, the rejection of claims 1 and 10 under 35 U.S.C. §103(a) is improper and should be withdrawn. First, there is no motivation to combine Song, Grochowski, and Hennessy in the manner suggested in the Office Action. Second, even if one were to combine the references in this manner, claims 1 and 10 patentably distinguish over any such combination.

One of ordinary skill in the art would not have been motivated to combine Song and Grochowski, as the two references relate to entirely different technical fields. Specifically, Song is directed to exception handling in a processor. Grochowski is directed towards the unrelated field of predicting predicate values in a predicated processor.

MPEP §2143.01 states that, “Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found in either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art.” Here, Grochowski does not disclose or suggest that the method for predicting predicate values described in the reference is suitable for use in the processor if Song. Significantly, there is no disclosure or suggestion that predicated execution would even work in the processor of Song. Thus, one of skill in the art would not have been motivated to modify the processor of Song to implement predicated execution, as taught by Grochowski

Further, even if one of skill in the art were to combine Song and Grochowski, one of skill in the art would not have been motivated to modify this combination based on the disclosure of Hennessy. The Office Action asserts that “Hennessy has taught that exceptions (breakpoints) may occur when an instruction is fetched. A person would have realized that if an exception occurs during fetch, then the fetch has failed and the instruction that is supposed to be fetched will not be decoded. As a result, it would have been obvious to one of ordinary skill in the art to not decode an instruction during precise watch mode.” While Applicants do not dispute that an exception may occur during the fetch stage of the instruction pipeline, there is no disclosure or suggestion in any of the references that decoding or execution should be halted because of such an exception.

Indeed, Song teaches away from the idea of not decoding an instruction if an exception occurs in the fetch stage. Specifically, Song discloses that for instruction fetch and decode related exceptions (IFDRE), the processor detects such exceptions at the fetch or decode stage and in response dispatches the instruction that causes such an exception to a reservation station of an execution unit. *See* Song, Col. 9, lines 47-64. Thus, Song explicitly teaches that instructions that cause exceptions during the instruction fetch stage are not stopped at the decode stage, but are indeed sent to the execution stage of the pipeline. Thus, one of skill in the art would not have been motivated to modify the combination of Song and Grochowski based on the disclosure of Hennessy to not decode an instruction because an exception occurs during fetch, as the Office Action asserts.

Accordingly, it is respectfully requested that the rejection of Applicants’ claims under 35 U.S.C. §103(a) be withdrawn.

Additionally, even if one were to combine Song, Grochowski, and Hennessy, Applicants’ claims patentably distinguish over any such combination.

Claim 1 is directed to a computer system for executing predicated instructions wherein each instruction includes a guard, the value of which determines whether or not that instruction is executed. The computer system comprises: a fetch unit for fetching instructions to be executed; a decode unit for decoding said instructions; at least one pipelined execution unit for executing decoded instructions and being associated with a guard register file holding values of the guards to allow resolution of the guards to be made; and an emulation unit including control circuitry

which cooperates with the decode unit to selectively control the decode unit to implement a precise watch or a non-precise watch on detection of a breakpoint wherein according to a precise watch, the instruction causing the breakpoint is not decoded by the decode unit and, according to a non-precise watch, the instruction causing the breakpoint and subsequent instructions are permitted to be supplied from the decode unit to the at least one execution unit while guard resolution in said at least one execution pipeline is awaited.

Neither Song, Grochowski, nor Hennessy discloses or suggests, “an emulation unit including control circuitry which cooperates with the decode unit to selectively control the decode unit to implement a precise watch or a non-precise watch on detection of a breakpoint wherein according to a precise watch, the instruction causing the breakpoint is not decoded by the decode unit and, according to a non-precise watch, the instruction causing the breakpoint and subsequent instructions are permitted to be supplied from the decode unit to the at least one execution unit while guard resolution in said at least one execution pipeline is awaited.”

The Office Action asserts that Song discloses precise watch and non-precise watch, as recited in claim 1, at column 22, lines 16-34. Applicants respectfully disagree with this assertion. The cited portion of Song discloses that the processor may operate in either an imprecise non-recoverable floating point exception mode or a precise floating point exception mode. In the imprecise floating point exception mode, the processor reports a floating point exception condition, without specifying which instruction cause the exception condition. When the processor handles the exception, the processor is permitted to be in a state where it has executed instructions subsequent to the instruction that cause the exception condition. In the precise floating point exception mode, the processor does not “early complete” a floating point instruction prior to finishing execution of the floating point instruction.

The imprecise floating point exception mode and the precise floating exception mode are different from the precise watch and non-precise watch recited in claim 1. First, the precise watch and imprecise watch recited in claim 1 are implemented on detection of a breakpoint, not detection of a floating point exception. A breakpoint is different from a floating point exception. A floating point exception occurs, for example, in situations where an instruction that performs an operation on one or more floating point numbers attempts to divide by zero, or perform a calculation that exceeds the number of bits allocated to store the result of the calculation. By

contrast, as described in Applicant's specification at page 9, line 10 – page 10, line 6, the precise and imprecise watches of Applicant's invention detect breakpoints. That is, for example, the precise and imprecise watches watch for access requests to particular addresses in the program memory or software breakpoints (i.e., special instructions with dedicated opcodes to cause a breakpoint). Detecting an access to a particular address or detecting an opcode is very different from detecting a floating-point exception, such as when an instruction attempts to divide by zero.

Further, Song does not teach or suggest circuitry that “cooperates with the decode unit to selectively control the decode unit to implement a precise watch or a non-precise watch.” Indeed, in the floating-point exception modes of Song, the instructions have already passed through the decode stage, as a floating point exception is not detected until the instruction is executed. Thus, the precise and imprecise floating point exception mode disclosed by Song does not cooperate in any with the decode unit.

Grochowski and Hennessy do not cure these infirmities of Song, as both Hennessy and Grochowski are unrelated to the detection of breakpoints.

Thus, claim 1 patentably distinguishes over Song, Grochowski, and Hennessy. Accordingly, it is respectfully requested that the rejection of claim 1 under 35 U.S.C. §103(a) be withdrawn.

Claims 2-9 depend from claim 1 and are patentable for at least the same reasons. Accordingly, it is respectfully requested that the rejection of claims 2-9 be withdrawn.

Claim 10 is directed to a method of debugging an on-chip processor which is arranged to execute predicated instructions wherein each instruction includes a guard, the value of which determines whether or not that instruction is executed. The method comprises: fetching instructions to be executed; decoding said instructions; executing decoded instructions, said executing step including resolving values of the guards of the instructions; and detecting instructions which have a debug effect and acting on said instructions in dependence on whether the processor is in a precise watch mode or a non-precise watch mode wherein, according to a precise watch mode, the instruction is not decoded and, according to a non-precise watch mode, the instruction and subsequent instruction are supplied and executed normally while guard resolution is awaited.

As is clear from the discussion above, neither Song, Grochowski, nor Hennessy, taken alone or in combination, teaches or suggests, “detecting instructions which have a debug effect and acting on said instructions in dependence on whether the processor is in a precise watch mode or a non-precise watch mode wherein, according to a precise watch mode, the instruction is not decoded and, according to a non-precise watch mode, the instruction and subsequent instruction are supplied and executed normally while guard resolution is awaited.”

Thus, claim 10 patentably distinguishes over Song, Grochowski, and Hennessy. Accordingly, it is respectfully requested that the rejection of claim 10 under 35 U.S.C. §103(a) be withdrawn.

Claims 11-15 depend from claim 10 and are patentable for at least the same reasons. Accordingly, it is respectfully requested that the rejection of claims 11-15 be withdrawn.

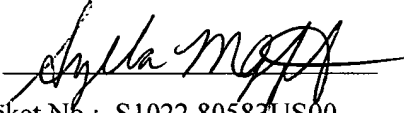
CONCLUSION

In view of the foregoing amendments and remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested. If the Examiner believes, after this amendment, that the application is not in condition for allowance, the Examiner is requested to call the Applicant's attorney at the telephone number listed below.

If this response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicant hereby requests any necessary extension of time. If there is a fee occasioned by this response, including an extension fee, that is not covered by an enclosed check, please charge any deficiency to Deposit Account No. 23/2825.

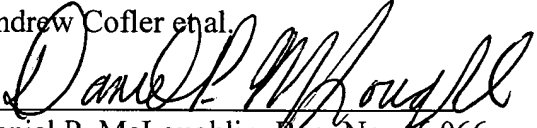
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Respectfully submitted,

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